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Cost Benefit Analysis of Providing Level II Trauma Care at
William Beaumont Army Medical Center (WBAMC)

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Abstract

The purpose of this retrospective study is to provide financial analysis of the costs associated with providing Level II trauma care to patients at William Beaumont Army Medical Center (WBAMC). Special focus is directed at civilian emergencies and their ability to pay for services.

During the period from 1 October 2000 to 30 September 2001, WBAMC, a designated Level II trauma center by the American College of Surgeons, provided care for 410 patients of which 181 were civilian emergencies. The civilian emergency patients were billed \$2,478,729.77 of which \$416,361.82 was collected for a loss of \$2,062,367.21. Only 31 civilian trauma patients made payments towards the care provided.

The civilian trauma patients required 486 bed days in the ICU and 643 days on the surgical ward for a total hospital stay of 1,129 days. The Length of Stay (LOS) for civilian trauma patients increased 75% (3.56 to 6.24 days) from fiscal year 1998 (before Level II certification) to fiscal year 2001. The Personnel costs associated with Level II trauma were \$1,444,790. Outpatient costs were \$47,245.

Reimbursements, staff costs, and outpatient costs represent the significant costs of Level II trauma. The cost of providing Level II trauma at William Beaumont Army Medical Center during Fiscal Year 2001 (FY01) was \$3,554,402.

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Cost Benefit Analysis of Providing Level II Trauma Care at
William Beaumont Medical Center (WBAMC)

Introduction

Research Question: What are the true costs of providing Level II Trauma care at WBAMC?

WBAMC has provided trauma care since 1972. Since acquiring American College of Surgeons (ACOS) Level II Trauma designation in July 1999, what additional costs have occurred? The assumption is that Level II designation has substantially increased personnel costs and length of stay (LOS) for trauma patients. This cost data will support the commander's request for additional funding to support trauma care.

Conditions which prompted the study

William Beaumont Army Medical Center (WBAMC), El Paso, Texas, a Level II Trauma Center, is one of two Army hospitals that are designated as Trauma Centers, the other being Brooke Army Medical Center (BAMC), San Antonio, Texas, which is a Level I trauma center. The hospital Commander and the Chief of Staff of WBAMC voiced concern about the cost of providing Level II trauma care in El Paso.

Challenges of Providing Health Care in El Paso

El Paso is a border town with over 560,000 residents, many of whom are poor and lack insurance. Juarez, across the Rio Grande River in Mexico, is a growing community of over 1 million residents, many of whom regularly commute to El Paso. It would not be an overstatement to say that this is an impoverished

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area. The poverty that afflicts many of the trauma victims causes trauma care to be prohibitively expensive for the hospitals that provide it. El Paso's two major for profit health systems - Sierra-Providence Health Network and Las Palmas Del Sol Regional Healthcare System - do not provide trauma care. Southwestern General Hospital, the only locally owned private hospital in El Paso also does not provide trauma care. This is not to say that ambulances do not visit their emergency departments. The ambulances that frequent these hospitals deliver injured patients of low severity/acute. These hospitals accept trauma patients only as a back up to WBAMC and Thomason Hospital.

Table 1

El Paso County

Population	679,622
El Paso population growth rate	14.9%
Texas population growth rate	22.8%
18-34 year olds that moved in 1990's	11,810
Total number who moved in 1990's	26,000
Median age	31
Percent Hispanic	78%
Percent who speak language other than English at home	74.8%
Percent with Spanish as the primary language	37%
Percent foreign born	25%
Percent living in female headed household	18%

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Percent living in female headed household below poverty level	41%
Percent of population in poverty	25%
Unemployment (Jan 2002)	8.4%
Unemployment for women (Jan 2002)	10%
Number unemployed (Jan 2002)	23,700
Households receiving public assistance or non-cash benefits	35%
Median income	\$28,236
National median income	\$41,349
High school dropout rate	40%
Percent over 25 with college degree	15.8%
Women over 25 with college degree	13.5%

Source: U.S. Census 2000

Shortages of Health Specialists

Low pay in comparison to other parts of the country has resulted in shortages of medical specialists in El Paso. For example, El Paso does not have a pediatric surgeon and experiences a critical shortage of neurosurgeons. Currently, Thomason Hospital and WBAMC have two neurosurgeons each. The medical staff shortage extends to x-ray and CAT scan technicians. The availability of ICU trained registered nurses is as much a limiting factor to expand trauma care as is the number of available beds. The local hospitals compete for a small pool of nurses.

Many of the military physicians assigned to WBAMC did not choose WBAMC as their first choice of assignment. El Paso is not

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seen as a desirable posting for many military physicians and very few extend their tours of duty while assigned there. The Army, like El Paso, has very few neurosurgeons and obtaining the necessary two for WBAMC is a constant struggle. The Army also has a limited number of vascular surgeons, nephrologists and anesthesiologists. These specialties are needed to maintain Level II status.

Table 2

Malpractice insurance in El Paso

Percent of El Paso doctors with malpractice claims	56.4%
Percent of Texas doctors with malpractice claims	51.7%
Number of malpractice claims per 100 physicians along border	34
Number of malpractice claims per 100 physicians in San Antonio and Austin	15
Percent increase in El Paso physician malpractice insurance rates	50%
Percent increase in malpractice insurance to Del Sol Medical Center, El Paso in 2001	35%

Source: El Paso Times 17 February 2002

Thomason Hospital

Thomason Hospital, the El Paso county hospital, serves as the Regional Advisory Committee (RAC) for far west Texas and southern New Mexico (Bureau, 2000). As the areas only Level I Trauma Center and RAC it is responsible for compiling trauma statistics throughout its region. Thomason cares for approximately 1,600 trauma patients annually in sharp contrast with WBAMC who cares for approximately 400 trauma patients. Texas Tech Health Sciences Center trains its residents at Thomason hospital. Currently, WBAMC sends its orthopedic residents there for training.

Thomason Hospital operates the local emergency medical system (EMS) responsible for transporting trauma patients to either trauma centers. Because of its location in the poorer section of El Paso, Thomason receives the majority of gun shot wounds (GSW) and penetrating traumas in El Paso.

Being a Level I trauma center does not imply that a trauma victim would be better treated at Thomason Hospital than at WBAMC. A Level I trauma center, among other requirements, must admit 1,200 patients annually to maintain the designation.

Patients with major injuries may be optimally cared for at either a Level II or I trauma center. A North Carolina study (Clancy, 2001) found case fatality to be 16.8% at Level I centers and 14.9% at Level II centers. This difference was not deemed statistically significant because of the severity of the cases. Hospital charges however, were significantly higher at Level I centers (\$47,366) than at Level II centers (\$35,490).

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This is due to the additional costs incurred by Level I trauma centers related to increased volume of patients and increased severity of injury of those admitted to their facilities.

Thomason Hospital, as the El Paso county hospital, is entitled to local tax dollars and state funds to fund its trauma program. Furthermore, Thomason is eligible for funds available to hospitals that provide a disproportionate amount of care to the uninsured. Currently, Veterans Affairs (VA) hospitals and military hospitals are not eligible for federal funds for trauma because of their federal status. Civilian hospitals are eligible for state and federal grants.

Why Did WBAMC Become a Level II Trauma Center?

The military draw down has threatened survival of WBAMC as a medical center. It survived the Base Closure and Realignment Commission (BRAC) in 1995 largely as a result of its Graduate Medical Education (GME) program. In 1996, however, the Department of Defense (DOD) threatened to terminate all its GME programs. The reason for this termination was that WBAMC possessed the approximate number of GME slots that DOD wanted to eliminate! If this had occurred, WBAMC would have been reduced to a MEDDAC or possibly a clinic.

The acquisition of formal American Council of Surgeons (ACOS) certification was seen as a way to enhance the reputation and stature of WBAMC as a MEDCEN worthy of additional resources and funding thus guaranteeing its future. The goal was to make WBAMC the premier triservice trauma-training site for all DOD Personnel. The assumption was that WBAMC would treat 1,000

trauma patients annually. This assumption was based on the fact that because many of these patients do not have insurance, Thomason Hospital would be more than happy to share the care of these very expensive trauma patients with WBAMC. That patient volume would provide trauma training for 100 surgeons every two years. Another assumption was that the reimbursement rate and payer mix would approximate Thomason Hospital. The assumptions concerning volume and collections projected revenues from trauma at approximately \$5,000,000 for WBAMC. Additionally, a trauma system named The Public Good Model was proposed. This foundation was a community wide initiative that was to result in a regional trauma fund. It was hoped that this would result in additional funds for WBAMC for trauma care. An unstated assumption was that the local politicians would obtain additional funds for trauma care.

What Went Wrong?

The projected volume of patients never came close. The much hoped for increase in volume that would result in acquiring Level I status and parity with Thomason did not happen. The number of trauma patients remained approximately the same. Level I trauma designation is based on volume and Thomason Hospital being the much larger hospital and operating the EMS maintained its usual patient volume to maintain Level I status. Rather than being an equal partner with Thomason Hospital, WBAMC became Thomason's backup.

The failure of the projected increase in trauma patients doomed the DOD-wide surgeon-training program. Furthermore, the

trauma patient population contained a significant number of civilian emergencies without health insurance. The Public Good Model never materialized and Texas politicians did not procure additional funding for WBAMC. The decreased patient volume coupled with a low reimbursement rate from the civilian emergencies contributed to the high costs of trauma care at WBAMC.

Without the volume to train the assigned residents the trauma program was forced to continue to send residents to other hospitals to receive trauma additional training. Other DOD surgeons did not come to WBAMC for trauma training and a key selling point of acquiring Level II status was lost. Additionally, projections for the ability of civilian trauma patients were based on Thomason Hospital's reimbursements. These very optimistic projections were not realized for Thomason Hospital and WBAMC with far less resources in billing personnel than Thomason was unable to match Thomason's reimbursement rates. The additional costs of the Level II program were paid for by WBAMC.

Benefits of Providing Level II Trauma Care at WBAMC

Enhancing surgical standards and training is a commendable and supportable endeavor. American College of Surgeons (ACOS) Level II certification has increased staffing requirements for the delivery of trauma care at WBAMC. This increased availability of surgical personnel has resulted in increased responsiveness of surgical intervention. These staffing changes and the cost in man-hours and dollars will be discussed.

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The current patient volume and severities of injury provides trauma care experiences to both the general surgery and orthopedic residents. The emergency department, ambulance section, Intensive Care Units (ICU) and surgical wards enhance their clinical expertise by caring for trauma patients.

The people of El Paso and the surrounding area definitely benefit from WBAMC's commitment to delivering the highest standard of trauma care possible to the community. Level II accreditation reflects favorably on WBAMC's department of surgery and its GME program. Of course, reputation and community stature are difficult to quantify, but in a period of downsizing, reputation and service to community cannot be dismissed as superfluous.

Literature Review

Trauma in El Paso

Trauma is a significant health problem in Texas as evidenced by the approximate 11,000 deaths in 1998 alone. It is the leading cause of death for populations 1 to 34 years old. The leading causes of accidental deaths were motor vehicle accidents (MVA) at 50% and then falls at 10% (CDC, 1998). There were 22,401 hospital admissions due to major trauma in 1998. Of these, 43% involved motor vehicles and 30% were the result of falls (TDH 98). Major trauma injuries increased in 1999 to 24,867 from 22,401 in 1998 (TDH 99).

Motor Vehicle Accidents make up a significant portion of trauma in El Paso County. El Paso reported 16,000 auto collisions in 2001. These Motor Vehicle Accidents resulted in

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5,000 injuries and 59 deaths (Gilot, 2002).

Table 3

Distribution of trauma patients to local hospitals

Hospitals	Patients	Percent
Thomason	1,592	66%
WBAMC	410	17%
Providence	188	8%
Sierra	119	5%
Culberson	75	3%
Southwestern	29	1%
Total	2,413	100%

* Culberson Hospital is located in Van Horn, Texas.

Table 4

Causes of trauma in El Paso area

Cause	Patients	Percent
MVAs	947	37.3%
Falls	876	34.4%
Other	508	20.0%
Shootings and Stabbings	181	7.1%
Unknown	31	1.2%
Total	2,543	100%

Table 5Types of injury in El Paso

	Number	Percent
Blunt*	1,438	56.5%
Penetrating	171	6.7%
Thermal	28	1.1%
Not given	906	35.6%

* MVA's and falls make up the vast majority of blunt injuries.

Table 6Types of injury of patients admitted to WBAMC

	Number	Percent
Blunt	347	84.6%
Penetrating*	55	13.4%
Thermal	8	1.9%
Total	410	100%

* Stabbings and gun shot wounds (GSW)'s comprise the majority of penetrating wounds. These type wounds are sought for training for WBAMC's surgical residents. These injuries are the type to be expected in a combat environment. Most of the GSW's and stabbings are directed to Thomason because they occur closest to that hospital.

Table 7**Causes of trauma of patients admitted to WBAMC**

Cause	Patients	Percent
MVAs	174	42%
Falls	137	33%
Accidents	43	10%
Assaults	40	10%
Other	9	2%
Self Harm	7	2%
Total	410	100%

* Only two patients were treated for gun shot wounds (GSW). Cruz (2002) states that the FBI rated El Paso as the third safest city for 2000.

The Role of the Trauma Registry

The trauma registry maintained by WBAMC not only provides a wealth of information to both the hospital for research and cost analysis but also for the state of Texas. Trauma centers tend to maintain more complete trauma records than non-designated centers.

A joint New Orleans study by Louisiana State and Tulane University examined and compared 2,702 patient records located in both the trauma registry and the administrative database of the hospitals surveyed. The researchers concluded that the

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trauma registry recorded more of the diagnoses, diagnostics, procedures, and outcomes in the care of trauma patients (Wynn, 2001).

Understanding the importance of accurate, quality data, WBAMC employs a trauma registrar who is responsible to ensure that the trauma registry is both complete and accurate. This has resulted in WBAMC trauma database that is useful for administrators and researchers alike.

Gathering the data for the WBAMC trauma registry is both a tedious and time-consuming process. The multiple entries require a exhaustive review of all documents relating to the trauma admission to include ambulance and emergency department documents that are often either incomplete or not legible.

Benefits of American College of Surgeons Certification

Trauma systems enable communities to sort and transport trauma patients to the most appropriate hospital for treatment. Ohio currently does not have an organized trauma system. This results in there not being an organized triage system for transporting patients to the most appropriate hospital which results in patients not receiving the necessary level of care. Severely injured patients experience better outcomes in acute care hospitals that offer trauma care than in other hospitals (Mancuso, 2000).

Implementing American College of Surgeons (ACOS) Level II criteria for transfers of seriously injured patients increased the survival rate from 7.5% to 25.5% at East Texas Medical Center, Tyler, Texas (Norwood, 1995). The state of Maryland

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increased the percentage of trauma patients seen within 30 minutes from 95% to 99% or an additional 461 patients annually by instituting a statewide trauma system (Voelker, 2000). WBAMC saw 410 trauma patients within 30 minutes 99% of the time.

The underlying premise for trauma centers is that caring for large numbers of trauma patients will result in that trauma center developing the expertise to properly care for these patients. The ACOS requires Level I trauma centers to admit at least 1,200 trauma patients yearly, and of those, 20 percent will have an Injury Severity Score (ISS) of 15 or greater, or there will be 35 patients per surgeon with an ISS of 15 or greater (Nathens, 2001).

The ISS is a summary severity score for anatomic injuries. Trauma Care Reimbursement Fund (2002) states that the ISS is based upon the Abbreviated Injury Scale (AIS) severity scores for six body regions:

1. Head and neck
2. Face
3. Chest
4. Abdominal and pelvic contents
5. Extremities and pelvic girdle
6. External

The ISS takes values from 1 to 75. Generally, the higher the score, the more serious are the patient's injuries. The ISS can be calculated by using injury descriptors or ICD9 codes. Injury descriptors tend to produce a more accurate ISS than ICD9 codes. The more detailed the descriptor, the more accurate the ISS.

For example, suppose a patient has five injuries distributed as follows:

Table 8:**ISS Example**

Region	Injury Description	AIS	Square Top Three
Head & Neck	Cerebral Contusion	3	9
Face	No Injury	0	
Chest	Flail Chest	4	16
Abdomen	Minor Contusion of Liver Complex Rupture of Spleen	2 5	25
Extremity	Fractured Femur	3	
External	No Injury	0	
Injury Severity Score:			50

- The three highest values from three different regions 3 (from region 1), 4 (from region 3) and 5 (from region 4)
- Thus the ISS is: $(3 \times 3) + (4 \times 4) + (5 \times 5) = 9 + 16 + 25 = 50$
- Since its introduction, the ISS has been the preferred method for combining AIS codes into a summary measure of anatomic injury severity.

Thomason Hospital treated 1,574 trauma patients. Of those

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patients 275 had an ISS of 15 or more. William Beaumont treated 410 trauma patients of whom only 54 had an ISS of 15 or more. This places WBAMC at the low end of volume for both a trauma center and cases per surgeon.

This is not to say that low volume hospitals (like WBAMC) should not seek ACOS certification. The process of trauma center verification holds smaller volume centers like WBAMC to a standard of care that would not be present without verification (Nathens, 2001). Many Level II standards such as 24/7 CT scan capability are now accepted as a routine practice.

There have been dramatic increases in survivability in communities that establish ACOS Level I and II trauma centers. Chicago, Ill., reported a 30% reduction in deaths among patients admitted to seven high volume trauma centers, defined as more than 200 seriously injured patients a year. A similar finding occurred in Napa County, California, where the preventable death rate decreased from 42% to 14% after establishing a Level II trauma center (Wenneker, 1990).

The mortality rate for WBAMC decreased from 5.69% (30/527) during FY 98 (before Level II) to 4.63% (19/410) during FY02. It is a fair assumption that the implementation of Level II standards played a part in the improvement.

Trauma systems do not automatically show immediate positive results. A national cross sectional time series analysis of crash mortality data covering period 1979 to 1995, indicated that an organized system of trauma care reduced crash mortality by 9%. The effect did not appear for ten years. Reasons for the

delay are that the maturation and development of triage protocols, interhospital transfer policies, trauma centers operations and quality assurance programs take time to successfully implement (Nathens, 2001).

The fact that it takes many years to plan for, develop, implement, and improve a community wide trauma system requires careful consideration of a decision to not renew Level II certification.

Clearly numerous studies show that implementation of ACOS levels of trauma reduce deaths by effective triaging, transporting, and treating severely injured trauma victims. Lower surgical mortality at trauma centers is not only due to more trauma trained surgeons and fewer mistakes with the operations themselves. It reflects more expertise with all aspects of care to include anesthesia and postoperative care (Birkmeyer, 2001).

Again, the mortality rates of both WBAMC and Thomason suggest that both institutions deliver superior care. WBAMC trauma patients experienced a mortality rate of 4.67% (19/410) and Thomason exhibited a rate of 5.7% (90/1,574).

Costs of Trauma Care

The primary attributes for a successful trauma center are commitment to residency training and specialized services including technologies such as Computed Tomography (CT) and Magnetic Radiation Imaging (MRI) (Bazzoli, 1995). Public hospitals, teaching and institutions receiving supplemental indigent care payments are best able to undertake the financial

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costs of providing trauma care (Bazzoli, 1996).

Federal grants are available to trauma centers as per US Code: Title 42, Section 300d-41. The purpose of these grants is to provide for the operating expenses of trauma centers that have incurred substantial uncompensated costs providing trauma care. Unfortunately, WBAMC is not eligible for these funds (US Code, 1999). This is because we are a Federal institution.

Lack of insurance makes trauma care a money-losing proposition. A study of insurance coverage involving 15 Level I trauma centers and 10 Level II trauma centers revealed that 31% of the treated patients had no insurance at all. A loss of 19.9% of total costs was reported by the centers (Eastman, 1991).

Trauma patients without insurance are far more likely to be transferred to a Level I or II facility. A University of Washington study analyzed transfers in a population involving 2,008 patients evaluated at Level III/IV trauma centers. Of these patients 12% were transferred to the local Level I center. Patients without commercial insurance were 2.4 times more likely to be transferred to the Level I facility (Nathens, 2001).

Having a Level I trauma center in the community gives other local hospitals an excuse to send patients to them. Often the hospitals state the transferred patients needed the definitive care that only a trauma center can provide. Often the patient's injury did not require transfer to a trauma center.

William Beaumont was only able to collect from 10.5% (19/181) of the civilian emergency trauma patients. Thomason Hospital was able to secure payment (+\$500) from 38% of her

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trauma patients (600/1574). The disparity in collections between the two hospitals is due to the greater amount of resources devoted to collections at Thomason. For example, the Texas Department of Health (TDH) has a satellite office to process emergency Medicare and Medicaid requests inside the main building at Thomason.

Insurance is one of many variables that affect costs. A Vermont study demonstrated that the age of trauma patients is an important factor in cost. Children and the elderly tend to be underinsured when compared to the general population. The length of stay is the greatest for the elderly defined as those older than 64. Children were the least expensive to care for (Sartorelli, 1999).

This proved true at WBAMC. The LOS of trauma patients older than 64 was 7.66 days (average charge \$12,121), for patients between the ages of 64 and 13 the LOS was 6.29 days (average charge \$13,361) and from 12 and under the LOS was 1.98 days (average charge \$5,625). The relationship between the age of the trauma patient and LOS and cost is also evident at the local county hospital. Thomason Hospital's LOS of trauma patients older than 64 was 5.78 days (average charge \$21,177), for patients between the ages of 64 and 13 the LOS was 4.55 days (average charge \$15,817) and from ages 12 and under the LOS was 3.47 days (average cost \$9,393).

Hospitals that exhibit skill in treating trauma patients resulting in low mortality rates incur higher costs than hospitals that exhibit higher mortality rates. The skill and

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resources directed towards preventing death in severely injured patients has financial consequences. A University of Michigan Health System study in Ann Arbor, Michigan demonstrated that for that trauma center the profit margin on nonsurvivors was \$5,898 greater than for survivors, even though the mean total cost for nonsurvivors was \$28,821 higher. Both groups became unprofitable after 21 days with nonsurvivors being more profitable (Taheri, 1999).

The WBAMC nonsurvivors were not profitable but were less costly than the average civilian trauma patient. Fifteen of the 19 trauma patients that died at WBAMC were civilian emergencies. Six died in the emergency department or were dead on arrival (DOA). These patients' families were not charged. Three patients died within 24 hours and their families did not reimburse WBAMC for the cost of their care, which amounted to \$22,621. The remaining six patients died on the 4th, 5th, 7th, 10th, 19th and 26th day of hospitalization respectively. Of their charges of \$150,429 a total of \$75,924 was collected. Overall the \$75,924 collected on charges of \$172,341 for a reimbursement rate of 44% resulted in these civilian patients costing WBAMC \$6,427 per patient. This is below the costs of 49% (89/181) civilian patients and also below the average cost of civilian trauma care which is \$13,694.

Reducing length of stay (LOS) is one strategy that hospitals employ to reduce trauma costs. The first day of care, however, should be the focus of cost containment. Taheri showed that the costs associated with the last day are insignificant

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when compared with total costs. Reducing LOS by one day reduced costs by less than 3%. The study shows that physicians and administrators should focus on care during the early stages of admission when resource consumption is at its highest (Taheri, 2000).

WBAMC with an average LOS of 6.18 days for the trauma patients keeps its trauma patients in the hospital longer than Thomason Hospital, which keeps its patients in the hospital for an average of 4.51 days. A large part of this difference can be attributed to Thomason's focus on discharge planning. They have 10 case managers to the one case manager employed at WBAMC.

Research supports the idea that trauma centers with sufficient volume should investigate the possibility of creating a trauma-specific ICU. A University of Alabama study involving 204 patients showed that closed trauma ICU improved clinical outcomes. The other benefits were decreased LOS and reduced costs (Park, 2001). BAMC in San Antonio, a Level I trauma center, utilizes a trauma-specific ICU.

A trauma specific ICU would not be cost efficient at WBAMC. Having only one 12 bed ICU and limited nursing staff, the RN's need to be able to work with all type of ICU patients. Specialization of the RN workforce would decrease the flexibility of staffing.

A North Carolina study showed that rural hospitals costs and charges increase with injury severity but reimbursement does not keep pace with increased charges. This study states that the rural hospital was projected to lose an average of \$25,000 for

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each patient with an Injury Severity Score (ISS) over 15 (Rutledge, 1996).

Although only 37 civilian trauma patients had an ISS of 15 or over, WBAMC lost an average of \$23,879.61 for each civilian trauma patient with an ISS over 15.

Economies of scale do not alleviate the high costs of care. A New York City study demonstrated that the Bronx Municipal Hospital, a 776 bed, Level I trauma center, lost \$441,700 in only one month caring for 209 trauma victims (Legorreta, 1993).

Thomason Hospital lost \$15,504,767 caring for 1,574 trauma patients during Fiscal Year (FY) 2001 for an average loss per patient of \$12,151. WBAMC with far fewer civilian patients lost \$2,062,367 caring for 181 civilian emergency trauma patients during FY 2001 for an average loss of \$11,394.

Not only does high volume not result in lower costs; it reduces favorable outcomes. A University of Florida study involving 30,930 patients showed increasing mortality with high volume defined as trauma centers treating over 1,000 cases annually. The increasing mortality with high volume may reflect over demand on resources (Tepas, 1998).

Thomason Hospital mortality rate of 5.64% caring for 1,594 trauma patients is 21% higher than the WBAMC rate of 4.63% caring for 410 trauma patients. This is to be expected because Thomason admitted 275 patients with an ISS of 15 or over versus WBAMC which admitted only 54.

Costs of maintaining 24/7 Operating Room (OR)

The dedicated operating room (OR) for urgent trauma care requires a significant volume of paying patients to compensate the staffing costs. A University of Minnesota study demonstrated it required 1,210 cases to break even using the 24-hour model versus 375 cases to break even using the on-call model (Brasel, 1998).

Level I and Level II trauma centers must meet the costly requirement of maintaining an in house OR team and an on call team 24 hours a day. Additionally, there are considerable training and planning requirements to ensure that the OR staff are able to react effectively to the arrival of trauma patients (Lewis, 1996).

Ideally, a Level II trauma center would have a complete OR team present while the in house OR team is performing surgery. This is both impractical and fiscally unsupportable in the current cost effective health care environment. The likelihood that an in-house team would be occupied at the same time that a second injured arrives and needs immediate surgical intervention is highly unlikely. This is especially true in a low volume trauma center (Lucas, 2001). Using queuing theory to determine OR staffing needs in a Level II trauma center Tucker demonstrated that the probability of two or more cases occurring simultaneously on the night shift is less than 0.1% (Tucker, 1999).

The Level I standards may demand in-house staffing demands that have questionable benefit. An Oklahoma study containing

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3,689 injured patients concluded that there was no significant difference in survival between patients that arrive at a Tulsa Community Hospital during normal operating hours (0700 - 1800 hours) and after hours (1801-0659 hours) when a surgeon is out of the hospital (Thompson, 1992).

Barone's 1993 study demonstrated that in-house OR coverage was not cost effective at Stamford Hospital, Stamford, Connecticut. Stamford Hospital admitted 659 trauma patients of which 86 underwent surgery within 12 hours. The patient outcomes were similar to three Level I trauma centers in the area utilizing in-house OR staff. Stamford Hospital accordingly decided to not pursue ACOS accreditation, which requires 24-hour in-house OR staff coverage (Barone, 1993).

William Beaumont maintains 24/7 OR staffing which consists of a Registered Nurse and an OR technician. Only 8 trauma patients underwent surgery in the OR within one hour of arriving in the emergency department. Three patients were treated during normal duty hours or first shift 07:00 to 15:00 hours and their surgery started at 7:17, 11:45 and 11:47 hours. The remaining 5 were treated during second shift 15:00 to 23:00 hours with their surgery starting at 16:49, 18:10, 19:54, 21:45, and 22:20 hours.

Of the 3 patients cared for during first shift one patient died within 24 hours. Of the remaining five patients treated during second shift 2 died; one within 24 hours of surgery and the other 19 days after surgery.

Table 9**Number and times of trauma surgery from arrival in Emergency****Department**

ER Arrival	Cases 1 st Shift	Cases 2 nd Shift	Cases 3d Shift	Total	Cumulative Percent of total
1 st hour	3	5	0	8	5.4% (8/147)
2 nd hour	3	1	6	10	12.2% (18/147)
3d hour	2	4	5	11	19.7% (29/147)
4 th hour	7	2	2	11	27.2% (40/147)
5 th hour	8	3	1	12	35.3% (52/147)
6 th hour	6	3	2	11	42.8% (63/147)
7 th hour	7	2	1	10	49.6% (73/147)
8 th hour	6	1	0	7	54.4% (80/147)

*The above table clearly shows that an on-call OR staff would have been able to respond to the trauma patients.

The literature clearly shows that the costs of providing trauma care can be prohibitive. There is considerable debate as to the clinical benefits of maintaining costly requirements of in-house staff. Trauma patients require costly procedures and many of the patients lack insurance. The trauma centers require a volume of patients to maintain a level of competency but there is an increase of bad outcomes as a hospital reaches its saturation point. Very few for-profit hospitals dare undertake trauma operations. Those who provide trauma care require some sort of state or federal funds to remain solvent.

Without a national initiative to fund trauma in the USA,

the present under funded system will continue to fall heavily on community-funded hospitals. This is unfortunate for the El Paso community because they have not the resources to adequately care for the entire trauma in El Paso County.

Government Accounting Office (GAO) Reports

A series of GAO reports address the underlying issues that affect the delivery of trauma care by WBAMC. Issues pertinent to this study include medical readiness, military reductions, tri-service cooperation, and military retention.

In order to provide necessary training for its surgeons, the DOD has explored the possibility of utilizing civilian trauma centers. One problem that currently exists is that the DOD has not yet estimated the number and type of military personnel that require trauma training. Also, because military personnel will be competing with the civilian centers' own personnel, there is concern that the military will not receive sufficient training. The challenge of DOD is determining the balance between combat readiness and peacetime healthcare requirements. There is support from the Army Surgeon General for WBAMC to deliver trauma training in El Paso; however, officials at WBAMC believe that \$2.7 million in start-up costs and annual funding of approximately \$1.4 million would be required for WBAMC to undertake caring for enough trauma patients to accomplish the training mission by training 330 military medical personnel per year in trauma (GAO, 1998).

The problem in determining the number of surgeons is that the number of surgeons needed for a wartime mission will be

either underutilized in peacetime or will have to treat non-beneficiaries to keep their skills current.

The Base Closure and Realignment Commission's (BRAC) round of base closing in 1995 analyzed 14 medical centers and 86 hospitals. William Beaumont Army Medical Center (WBAMC) was included in this analysis. The BRAC was looking to identify hospitals and medical centers that could either be eliminated or down sized that were clearly at over capacity. Defining overcapacity however, depends if you are looking at the wartime mission, peacetime mission, or some combination of both. The DOD's health care system's primary duty is to care for active duty personnel and be prepared to provide health care during times of war. Additionally, DOD must also care for nonactive-duty beneficiaries. Because of this added requirement, downsizing decisions must take into account the cost-effectiveness of maintaining a military medical capacity larger than is needed for only wartime purposes. Per BRAC guidelines, the key requirement for a medical center is that it must possess at least two graduate medical programs (GMP) (GAO, 1995). From this report it appears apparent that GMP is critical for designation as a military medical center (GAO, 1995).

As of 1997 the Army had approximately 1,300 Graduate Medical Education (GME) trainees. The Navy had approximately 900 GME trainees and the Air Force had 800 GME trainees. The estimated costs for the DOD GME program at that time was in excess of \$125 million dollars annually. The student costs were highly variable ranging from \$20,000 to \$100,000. These costs

were at best an educated guess because the military facilities were unable to accurately measure the GME costs. Although the DOD was unable to clearly define the total number of GME trainees needed to meet future demands, it was determined that the GME programs would be subject to the same policies and downsizing that affected the other military programs. In the summer of 1997, the Army Surgeon General, acting on internal recommendations, closed all GME programs at WBAMC. The reason given was that the Army needed to eliminate approximately 50 GME trainee positions, and WBAMC 64 GME positions would accomplish the reduction. William Beaumont Army Medical Center officials contended that these cuts were arbitrary and that WBAMC had recently scaled back its GME program. Additionally, medical center officials and local politicians argued that the level of care for DOD beneficiaries in El Paso community would be devastated. The El Paso area is medically underserved and the loss of the GME programs would result in the loss of specialists that are critically needed by the community. In response to these arguments, the Army reconsidered the earlier decision but still faces the need to reduce the number of GME programs (GAO, 1998).

The Defense Department needs to conduct systematic analysis to monitor retention in key occupations. This retention information is necessary in order for Congress to facilitate decisions regarding personnel strengths. Timely and accurate assessments need to be done on a systematic basis to identify problems early on and tailor policy accordingly (GAO, 2000).

Adequacy of the health workforce is an important national issue. The distribution of health professionals is especially acute in rural and inner cities. These areas experience difficulties recruiting and retaining health care professionals. The shortages of nurses, radiology technicians, laboratory technicians, and medical aides have an impact on the quality of patient care. Current levels of dissatisfaction among nurses will affect the future supply of nurses. Improvements in the workplace will not reverse the demographic forces that will widen the gap between the number of people requiring nursing care and the nursing staff available to provide care (GAO, 2001).

Doctor Pay

In order to understand the necessity of the GME programs you have to know what civilian orthopedic and general surgeon compensation is. There are a variety of surveys that attempt to target doctor pay. Earnings differ whether a doctor has his own private practice, is in a partnership or is a member of a large multispecialty group. The average high range of earnings for general surgeons is \$281,799 and \$365,625 for orthopedic surgeons. Starting pay for general surgeons is \$145,000 to \$300,000 and is \$170,000 to \$300,000 for orthopedic surgeons. These figures underscore the opportunities that exist for military doctors in the civilian marketplace (Azevedo, 2001).

Military doctors not only forgo the annual extra pay they could earn on the outside, they also lose out on the

opportunity to build a practice. The peak earning years for doctors is between 11 and 20 years of practice and between the ages 50 to 54 years. The volume of patients seen and the number of hours worked will appreciably increase a doctor's earnings. Neurosurgeons are the highest compensated specialty with 13% earning \$600,000 or more. Fifty percent of neurosurgeons earn over \$300,000. Thirty one percent of orthopedic surgeons and 11% of general surgeons earn over \$300,000 (Goldberg, 1997).

In January 2001, a board certified orthopedic surgeon Army Medical Corps Colonel with 26 years service would receive \$149,152 annually. An Army Major with the same specialty would receive approximately \$114,468. Army neurosurgeons receive the same pay as orthopedic surgeons. General surgeons receive \$7,000 less in Incentive Special Pay (DFAS, 2002)

The scarcity and high cost of surgeons underscores the necessity of the DOD to continue the GME programs in these specialties. Not only are the costs to hire these specialists prohibitive, they may be unavailable in the area they are needed. This problem currently exists in El Paso where the only recourse to staff neurosurgery and anesthesiology is through Army Medical Corp Physicians.

Readiness and Military Trauma Care

In an attempt to provide trauma care experience for entire surgical teams, the Army utilized Ben Taub General Hospital (BTGH) in Houston, Texas as the site for Combat Trauma Surgical Training (CTST) for Forward Surgical Teams (FST). BTGH provides care for about 2,800 trauma patients a year, with 900

penetrating trauma cases. A 4-week program provided valuable trauma training for an entire FST (Tyke, 2000).

Although there is a clear need to provide clinical experiences for Army medical personnel, the high cost of providing this experience at Army hospitals may prove too expensive without additional funding. For example, the treatment of gunshot wounds (GSW) is a necessary skill that Army surgeons must acquire to successfully function in a combat environment. Acquiring this skill however, does not come cheap. The average cost of a GSW in the United States is \$17,000 of which the taxpayer pays for 50% (Cook, 1999).

The challenge for the Army is to provide realistic trauma training for its soldiers while not degrading its peacetime mission of providing care for its beneficiaries. Ideally, trauma training at an Army Medical Center would accomplish both missions. Unfortunately, neither William Beaumont Army Medical Center nor Brooke Army Medical Center admit a sufficient number of trauma patients to provide trauma training for all personnel who need it.

Graduate Medical Education and Trauma Care

A Portland, Oregon study compared teaching and community hospitals in regards to their ability to deliver trauma care. Nine American College of Surgeons Committee on Trauma (ASCOT) criteria were monitored for availability at each institution: 1) emergency department; 2) trauma surgeon; 3) operating room; 4) anesthesiologist; 6) intensive care unit; 7) on-call surgeon; 8) neurosurgeon and 9) computerized axial tomography (CT). The

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results were that with the exception of the operating room, because of the heavy volume of elective surgery, teaching hospitals generally maintained staff and services more successfully than did the community hospitals. Additionally, less day-to-night variation in resource availability occurred at the teaching hospitals. Anesthesiology, ICU beds, trauma surgeons, neurosurgeons and CT were more available at night than at the community hospitals (Neely, 1991). Trauma care and GME are linked in that you cannot successfully deliver care without GME. Conversely, the leaders of the department of surgery at WBAMC believe that the GME program is dependant on maintaining Level II status. This is because the specialties required by Level II status also maintain WBAMC as a medical center and only a medical center can have a GME program.

There are both direct and indirect costs incurred in GME programs. Direct costs include program administrative costs. Indirect costs are the higher patient care costs that are a result of their educational activities. Total costs are very difficult to determine because the activities of patient care, research and education are so closely intertwined (Council, 2000).

Determining costs of GME often focuses on clinical and administrative costs. Blewett, 2001, maintained in his University of Minnesota study that faculty costs were 52% of the total GME program's costs. Surgical residencies had the highest faculty costs.

Mechanic (1998) conducted teaching hospital costs research

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involving 4,764 nonfederal hospitals including 1,014 teaching hospitals. He concluded that in 1993, academic medical center costs per case were 82.9% higher than those for urban non-teaching hospitals. The actual costs were \$9,901 and \$5,412 respectively. Non-academic medical center teaching hospitals costs per case were 22.5% (\$6,630) higher than those of non-teaching hospitals (\$5,412). After adjustments for case mix, wage differences and direct GME costs, academic medical centers were 44% more costly and other teaching hospitals were 14% more costly than non-teaching hospitals. These high costs have raised questions concerning the efficiency of residency programs, their alignment with national health workforce needs and the financial benefits provided to the hospitals that maintain GME programs.

An innovative methodology was utilized by Mc Neil (1994) to capture the costs of orthopedic and obstetrics - gynecology (OBGYN) GME. Simply comparing department costs between Army facilities with GME programs and those without he estimated the costs per orthopedic resident to be \$215,425 and \$182,775 per OBGYN resident.

The obvious conclusion is that GME programs are extremely expensive and providing civilian emergency trauma patients for GME trainees adds to the cost. The problem is that without these expensive GME programs hospitals cannot provide trauma care.

The High Costs Associated With Civilian Emergencies

Walton (1995) conducted an exhaustive study of charges associated with treating civilian emergencies at Wilford Hall Medical Center, in San Antonio, Texas. He concluded that charges

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for this care amounted to \$5,360,600. At the time of this study there was growing concern that the DOD could not continue to write off these expenses. Wilford Hall's GME program in Emergency Medical Services is dependant on these very expensive patients to maintain its existence much like our GME programs are dependant on patients admitted through the emergency department.

GAO (2000) states that there are a number of emergency departments that could be closed because of low volume. The identified emergency departments will not be closed at this time because the institutions affected stated that the GME program depended on them staying open. The GAO concluded that DOD emergency departments provide mostly non-emergency care much like their civilian counterparts. Lastly, the GAO estimated that between 23 and 66 percent of care provided went to patients not enrolled in TRICARE Prime.

A WBAMC emergency department costs per admission study conducted by Wagner (1997) concluded that the average cost per indigent patient admitted through the emergency department was \$8,806. The total cost for these patients was \$17,258.93.

What exactly are the requirements for a Level II trauma center?

The definitive guide for ascertaining American College of Surgeons Committee on Trauma (ACS COT) requirements is *Resources For Optimal Care Of The Injured Patient:1999*. This guide lists not only the clinical, facility, administrative and educational requirements but also promotes a systems approach to trauma care. Some of the more costly requirements are 24-hour

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availability of general surgery, anesthesia, emergency medicine, neurosurgery, obstetrics/gynecologic surgery, oral/maxillofacial surgery and radiology. Clinical qualifications include staff board certified in general/trauma surgery, emergency medicine, neurosurgery, and orthopedic surgery. There are additional education requirements some of which include 16 hours Continuing Medical Education (CME) and Advanced Trauma Life Support (ATLS) Course of the American College of Surgeons. Level II requirements require 24-hour availability of angiography, sonography, x-ray, and computed tomography. The trauma surgical director, the nursing trauma coordinator and the trauma secretary are three staff whose duties are primarily focused on the successful implementation of trauma care and therefore their salaries are a direct cost of trauma care (Committee, 1999).

Methods and Procedures

The Patient Population

The sample or study group will be the 410 patients listed in the trauma registry from October 2000 to September 2001. The trauma coordinator at WBAMC maintains this trauma registry (TR). Another source of data is the Composite Health Care System (CHCS) and the Patient Administration Division (PAD) maintains this data source.

The dates covered for this study are 1 October 2000 to 30 September 2001. Both databases were crosschecked to ensure validity and reliability. Patient charges and reimbursement information will be extracted from these databases.

Table 10**Trauma beneficiary category**

Civilian Emergency (CIV)	181	44.1%
Active Duty Military (AD)	65	15.8%
Retired Military (RET)	43	10.4%
Family Member of Active Duty (FMAD)	44	10.5%
Family Member of Retiree (FMRET)	51	12.4%
Veteran Affairs Beneficiary (VAB)	24	5.8%
Other	2	.48%
Total	410	100%

RESULTS

The following descriptive statistics and tables provide insight and understanding of the trauma population. Financial areas presented include total charges, total reimbursement, average charge and average reimbursement by patient category.

Reimbursements**Table 11****Total charges and reimbursements**

		Average per patient
Total Charges	\$5,146,702.67	\$12,552.93
Total Reimbursements	\$2,995,211.32	\$7,305.39
Total	-\$2,151,491.35	-\$5,247.53

Table 12**Charges and reimbursements from civilian trauma patients**

		Average per patient
Total Charges	\$2,478,729.77	\$13,694.64
Total Reimbursements	\$416,361.79	\$2,300.34
Total	-\$2,062,367.21	-\$11,394.29

WBAMC is reimbursed 100% for all care given to qualified beneficiaries. Veteran Affairs beneficiaries are charged less than DRG rate per a cost sharing agreement with WBAMC. Currently, the Defense Finance and Accounting System (DFAS) covers civilian emergency patients bad debt. Only 29 civilian emergency trauma patients or 16.02% made payments on their bill.

Table 13**Age, Injury Severity Score (ISS), Intensive Care Unit days (ICUD), Hospital Days (HD), Charges**

Average	Age	ISS	ICU days	Hospital days	Charges
Civilian	31.9	7.50	2.69	6.24	\$13,694.64
Active Duty	28.8	5.07	.64	6.09	\$11,232.23
Retiree	68.9	7.41	2.43	8.02	\$12,339.13
FMAD	17.3	4.97	.79	3.27	\$12,061.91
FMRET	66.2	6.40	.56	7.44	\$10,484.15
VAB	67.8	8.08	1.50	5.70	\$8,229.32
Total	40.2	7.5	1.79	6.18	\$12,552.93

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Civilian emergency patients consume the most ICU days. VAB patients are the most severely injured and are the most expensive to care for. Remember the VAB patients are charged approximately 50% the DRG rate per a cost sharing agreement that sets the rates the VA reimburses WBAMC for services.

Table 14

Comparison in civilian trauma patients' ICU Length of Stay (LOS) between fiscal years (FY) 1998 and 2001

	Number patients	ICU days	Average days
FY 1998	234	372	1.59
FY 2001	181	486	2.69
Difference			.90 (+ 69%)

Table 15

Comparison in civilian trauma patients' Ward Length of Stay (LOS) between fiscal years (FY) 1998 and 2001

	Number patients	Ward days	Average days
FY 1998	234	460	1.965
FY 2001	181	643	3.55
Difference			1.585 (+ 80.6%)

Table 16

**Comparison in civilian trauma patients' Total Length of Stay
(LOS) between fiscal years (FY) 1998 and 2001**

	Number patients	Total LOS days	Average days
FY 1998	234	832	3.56
FY 2001	181	1,129	6.24
Difference			1.585 (+ 75%)

Table 17

**Comparison in number of civilian trauma patients' with Total
Length of Stay (LOS) of 1 day between fiscal years (FY) 1998 and
2001**

	Number patients	Percent of Total
FY 1998	127	54%
FY 2001	70	38%

Level II status requires caring for civilian trauma patients through their entire in-patient hospitalization markedly increased the LOS of these patients. If WBAMC had been able to treat and transfer, as they had in 1998, there would have been a substantial savings as measured by bed days.

Table 18

Comparison in civilian trauma patients' Lengths of Stay (LOS)
using fiscal years (FY) 1998 and 2001 rates

	ICU LOS	Ward LOS	Total LOS
FY 1998 rate	288	356	644
FY 2001 rate	486	643	1,129
Difference	+198	+287	+485

An ICU trauma patient at WBAMC historically requires 12 hours of Registered Nursing daily (One RN cares for two ICU patients per 8 hour shift). A typical ward trauma patient requires 4.8 hours of RN coverage daily (One RN cares for 5 Ward trauma patients). This staffing requirement is based on patient acuity found in the Workload Management Nursing System (WMNS).

Table 19

Estimated costs of Level II trauma measured in in-patient
Registered Nursing hours.

	Bed Days	RN Hours per patient	Total
ICU	198	12	2,376
Ward	287	4.8	1,377
Total RN hours			3,753

Outpatient Costs

WBAMC provided not only inpatient care for the civilian trauma patients but also continued to follow those patients as outpatients. The primary reasons for this extension of services were that the patients did not have a primary physician to be followed up by and/or the residents needed the training.

Table 20**Outpatient clinic costs of civilian trauma patients FY 2001**

Clinic	Visits	Cost	Total
Brace	3	\$137.00	\$411.00
Cast	23	\$130.00	\$2,990.00
Emergency Department	6	\$255.00	\$1,530.00
Hand	7	\$112.00	\$784.00
Neurosurgery	6	\$366.00	\$2,196.00
Orthopedic	80	\$211.00	\$16,880.00
Pediatric	1	\$134.00	\$134.00
Physical Therapy	1	\$83.00	\$83.00
Occupational Therapy	6	\$110.00	\$660.00
General Surgery	36	\$316.00	\$11,376.00
Peripheral Vascular	1	\$145.00	\$145.00
Sum	170		\$37,189.00

Table 21

Outpatient medication and radiology costs of civilian trauma patients FY 2001

Type	Number of Patients	Cost
Medication	114	\$4,039.00
Radiology	28	%6,017.00
Sum		\$10,056.00

Personnel Costs

The salaries of personnel required by American College of Surgeons Committee on Trauma (ACS COT) per their guidelines for staffing a Level II trauma center will comprise personnel costs. These requirements are published in *Resources For Optimal Care Of The Injured Patient: 1999* (Committee, 1999).

Level II trauma guidelines require that a hospital have 24-hour in house computed tomography (CT) technician, X-ray technician with an angiograph tech on call. Additionally, an OR RN and an OR tech must be 24-hour in house. Currently an Army Nurse Corps Major is the trauma coordinator. The use of GS11 pay is used for illustration because that is the pay rate of civilians who perform this duty in San Antonio. All GS pay rates are at step 1 and do not include overtime pay or any additional pay or bonuses.

The additional hourly cost of board certification for the contract emergency room doctors was \$30/hour. WBAMC paid 5,993 hours at this rate for a total of \$177,990.

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Having an in-house 24/7 anesthesiologist required utilizing contract anesthesiologists. They were paid \$163.13/hour and WBAMC paid them for 4,333 hours. The cost of this 24/7 anesthesiologist was \$706,435.

Table 22

Personnel Costs of Staffing Level II Trauma

Title	Pay	Amt.	Cost *	Benefits*	Total Cost
Trauma Coordinator	GS11	1	\$43,326	\$10,788	\$54,114
Anesthesiologists	Contract		\$706,435	-	\$706,435
Board certified ER	Contract		177,990		177,990
Trauma Registrar	GS5	1	\$23,633	\$5,885	\$29,518
CT Tech	GS8	3	\$32,419	\$8,072	\$121,473
X-ray Tech	GS6	3	\$26,342	\$6,559	\$98,703
Angiography Tech	GS8	1	\$32,419	\$8,072	\$40,491
OR RN	GS9	3	\$35,808	\$8,916	\$36,699
OR Tech	GS5	3	\$23,633	\$5,885	\$88,554
RN ICU	GS11	1	\$43,326	\$10,788	\$54,114
RN 7E	GS9	1	\$35,808	\$8,916	\$36,699
Total Labor					\$1,444,790

* Calculated in 2001 Dollars

** Benefits 24.9%

Table 23**Sum of Reimbursement, Personnel and Out-Patient costs**

Costs	Amount
Unreimbursed Civilian Trauma Care	\$2,062,367
Outpatient visit, medication & radiology	\$47,245
Personnel salaries of staff involved with trauma	\$1,444,790
	Sum
	\$3,554,402

Discussion

The economic situation in El Paso is not likely to improve in the near future. The ongoing exodus of manufacturing jobs will continue to erode the tax base on which the County hospital Thomason relies on to meet costs of indigent care. The loss of jobs will increase unemployment with resulting lack of health insurance. The brain drain away from El Paso will make it increasingly difficult to hire essential providers, nurses and medical support personnel such as coders and radiology technicians.

Along with its economic woes, the high cost of malpractice insurance in El Paso will continue to cause providers to relocate. This also contributes to the shortage of specialists required to care for trauma victims such as neurosurgeons, vascular surgeons and anesthesiologists. The increasing malpractice premiums for local hospitals will affect hospitals'

ability to accept non-paying patients.

WBAMC proximity to Mexico presents additional concerns about the future costs of trauma care. The city of Juarez cannot currently adequately provide care for its citizens. The rapid growth in recent years has overwhelmed its medical infrastructure. The continuing population growth will increase the number of Mexican citizens seeking medical care in El Paso. Patients admitted to El Paso hospitals are already finding it difficult to discharge patients back to Mexico for follow-up care.

Thomason Hospital is near its saturation point and has become less willing to accept transfers from WBAMC. The County's economic problems will likely see a Thomason adopt a more restrictive lateral transfer policy. As of the time of this paper, a written transfer agreement between Thomason and WBAMC does not exist.

The County of El Paso has become dependant on WBAMC to provide trauma care for indigent patients. This dependence is likely to continue because of economics. WBAMC in effect is subsidizing trauma care in El Paso.

The leadership at Thomason hospital have decided to maintain Level I trauma status. This requires them to admit a disproportionate share of trauma patients. There are not enough trauma patients for two Level I trauma centers in El Paso.

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Additionally, in order for Thomason to maintain their residency programs with Texas Tech Health Science Center, they must ensure that their residents have adequate trauma patients to perform surgery on. Thomason hospital admitted 275 patients with an ISS of 15 or more while only 54 of this type of seriously injured patient was admitted to WBAMC. This has resulted in WBAMC residents not having sufficient trauma patients. WBAMC must send the surgical residents out of hospital TDY to gain needed experience. This in retrospect may be a bargain because each civilian trauma patient with an ISS over 15 cost WBAMC \$23,879.61

Not only does WBAMC not have a sufficient volume of severely injured patients to provide adequate training, the type and number of the trauma victim's is also lacking. WBAMC only received 55 penetrating injuries of which only 2 were gun shot wounds. The lack of armed gang violence is a commendable feature of El Paso but it is not a conducive environment for surgeons to gain experience in treating combat type injuries.

Trauma patient's clinical outcomes have improved since 1998. The benchmark for the efficacy of trauma is mortality rates. The decrease in mortality from 5.69% (30/527) in FY98 to 4.63% (19/410) in FY 01 translates to 4 trauma patients surviving who would not have if FY98 mortality rates were applied. Further study would be required to analyze each death

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to determine if Level II procedures were the key factor and if
the change was in fact statistically significant.

If being sued is any indication of quality care, then the WBAMC trauma program should be commended. Currently there are no lawsuits pending from care received by the trauma patients treated during the time span of this study.

The lack of reimbursement from the civilian emergency trauma patients admitted to WBAMC is due to a combination of patient lack of health insurance and WBAMC's Patient Administration Department's inability to quickly and efficiently process trauma patients to secure payment. For example, WBAMC is dependent on the individual patients or their families going out and securing emergency Medicare and Medicaid on their own. Additionally, because securing payment from insurance companies is both a time consuming and labor intensive affair, WBAMC may need to hire additional billing staff to accomplish efficient billing. Thomason devotes proportionately far more resources to billing than WBAMC and even has a Texas Department of Health branch in its main building but it too loses money on trauma care. The question becomes whether devoting additional resources to the Treasurer would be cost effective for WBAMC.

The length of stay of trauma patients is likely to remain high resulting in additional costs. This is as much a factor of WBAMC being a teaching hospital and the civilian trauma

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patient's lack of insurance. Civilian trauma patients present unique problems for the WBAMC case manager. For example, a Mexican family can refuse transfer back to Mexico. The case manager cannot go around the family and make arrangements for transfer with the Mexican consulate without their permission. Some trauma patients speak no English and have no immediate family in area. The prolonged stay of some trauma patients and the extensive services they require of the case manager places demands on WBAMC that are not easily addressed.

The real danger from civilian trauma patients is that they could tie up the ICU and force WBAMC to send beneficiaries to civilian hospitals for care. An additional cost of trauma is the cost of not being able to admit beneficiaries because the ICU is closed to medical patients. Fortunately thus far, WBAMC has not experienced a prolonged ICU saturation.

With only 8 trauma patients undergoing surgery within one hour from arrival to the emergency department, the Level II requirement of 24/7 OR staffing proved expensive and a gross underutilization of assets with little in the way of clinical outcomes to justify the expense. The same can be said for 24/7 CT-scan coverage. None of the patients requiring immediate surgery had a CT-scan prior to surgery. The reason for this is because there simply is not enough time for a CT-scan prior to surgery.

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William Beaumont Army Medical Center is in a difficult situation regarding Level II trauma, GME and costs. WBAMC saves money by not having severely injured trauma patients admitted to her but in doing so it pays for underutilized OR and radiology staff and must pay to have surgical residents go TDY for additional training. If on the other hand, WBAMC admitted more civilian trauma patients, she would incur the costs of these very costly patients and would most likely cause the ICU to be closed more often to medical emergencies resulting in more beneficiaries being sent to civilian hospitals for treatment at great expense. The increased number of trauma patients would increase the number of internal medicine consults resulting in fewer available Prime Adult Medical Clinic appointments. The trauma patients would increase the waiting time in the emergency department resulting in patient dissatisfaction. The additional trauma patients would require the hiring and training of additional caseworkers to assist in discharge planning.

Even with additional trauma patients the residents would still have to go TDY to receive surgical experience on gunshot wounds, burns, and pediatric trauma. Because of this, careful scrutiny must be given to plans to decrease TDY spending by increasing trauma admissions.

The low volume that WBAMC currently experiences is sufficient for teaching purposes for the GME. Each case is

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thoroughly examined and information is shared with all the residents. The amount of money spent on TDY covers shortfalls in trauma volume and type (burns and gun shot wounds) and it allows the residents to experience different working environments.

On the issue of outpatient care (visits, medication, and radiological exams), the costs of these visits has to be weighed against not only what is best for the patient but also the training value of allowing the residents to see the results of their care. Often these patients do not have a personal doctor to be transferred to nor do they have the money to fill the prescriptions. Most importantly, the providers must ensure that the standard of care is met for the trauma patients.

Regarding GME costs, one military researcher (McNeil, 1994) estimated orthopedic resident costs as \$215,425 per resident per year. If we are to accept these figures, the WBAMC Orthopedic GME program is about on par with other military organizations. The bottom line is no one can definitely state what are the costs of any GME program.

In conclusion, the decision is whether the costs of Level II trauma are justified by the benefits to the GME program or are the requirements of Level II trauma inappropriate for WBAMC due to high cost, underutilization, and insufficient improvement in clinical outcomes.

Recommendations

There can only be two courses of action. Maintain Level II trauma or withdraw. There are seemingly apparent benefits and drawbacks to each. The prevailing assumptions for maintaining Level II trauma follow.

Maintaining Level II status**Excellence**

Maintaining Level II status WBAMC ensures that the highest standards of trauma care are met. This not only benefits the El Paso community but also our own beneficiaries who make up approximately 50% of the trauma patients.

MEDCEN

Maintaining Level II status ensures that WBAMC is provided with necessary specialists such as neurosurgeons and anesthesiologists. Because these specialists are a necessary component of Level II, having them ensures WBAMC status as a Medical Center.

GME

The Level II program enhances the GME program. It exposes the residents to the whole spectrum of trauma care to include inpatient and some outpatient care. Without Level II the patients would be treated surgically then transferred as soon as stable. Doing this would deny the residents the experience of following the trauma patient after surgery. The follow-up care

Trauma Cost Analysis is an essential part of trauma treatment. Also having trauma care here at WBAMC allows the staff to reinforce trauma lessons through repetition and reinforcement. Training off-site at another hospital such as University of Houston may expose the resident to a volume and severity of trauma not found at WBAMC but the trauma skills and experience will be forgotten because they are not used.

Saving Lives

Mortality rates for trauma victims have fallen with the implementation of Level II guidelines. By dropping Level II, WBAMC risks a resumption of earlier rates of mortality. This is sure to result in deaths that would not have occurred had Level II standards been maintained.

Just because there were few immediate surgeries does not necessitate doing away with in-house OR staff. The situation can change literally overnight.

Trauma Costs are covered.

The low reimbursement rates can be improved with greater efficiency on the part of the billing department. DFAS has covered the uncollected bad debt in the past and is instituting policies to recoup uncollected payments at their level.

Downsizing

By dropping Level II trauma status, WBAMC will be

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perceived by the El Paso community as not being able to deliver quality care. WBAMC will be seen as second best to Thomason Hospital. Additionally, the need for critical specialties will be not filled by MEDCOM. This will result in a dangerous situation for the community of El Paso because there is a shortage of neurosurgeons in El Paso and removing the military neurosurgeons would put the entire community at risk.

Readiness

America is at war with terrorism and the future is uncertain. The need for qualified trauma surgeons can increase with the next terrorist attack. The Level II program should be viewed as a necessary and vital aspect of readiness.

Not renewing Level II status

Level II standards do not fit WBAMC

WBAMC can continue to maintain high standards of trauma care without Level II certification. The ACOS standards may not be appropriate for the patient volume.

Level II standards limit flexibility

Without Level II status the leadership of WBAMC can decide if on-call is more cost effective than in-house staffing and adjust staff to maximize their utilization. For example, Monday through Wednesday are historically the slowest days of the week for trauma. On call may be more cost effective than in-house. Likewise in-house may be more appropriate during Friday and Saturday night because historically those times are the busiest.

This staffing flexibility would reduce wasted resources in OR and radiology.

Need to establish new relationship with Thomason Hospital

WBAMC needs to reassess its relationship with Thomason hospital. Thomason has not acted as an equal partner with WBAMC as far as volume and type of patients sent to WBAMC. Withdrawing from Level II would transfer to Thomason the high cost indigent patients that are currently treated at WBAMC.

Workload determines assignment of medical specialists

The decision to keep or decrease the number of specialists at WBAMC will be based on the needs of the entire Army. The trauma mission at WBAMC never produced the volume required to justify additional specialists. This has resulted in little depth in specialists and some (like the vascular surgeon) being on perpetual call.

GME will continue without Level II

Before Level II trauma, WBAMC cared for the same type of patients that it does now. Before Level II, the patients were kept in the hospital approximately 3 $\frac{1}{2}$ days versus approximately 6 $\frac{1}{2}$ days after Level II. There were more civilian trauma patients to treat before Level II (234 v. 181) thus it can be argued that the learning opportunities before Level II were approximately the same. Just as there was not a major change in clinical practice with the assumption of Level II, there will not be a major change in operating procedures when Level II is dropped.

Not enough trauma to meet GME requirements.

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The residents will continue to travel TDY to obtain the required trauma experience. The volume of beneficiary trauma patients does not provide enough workload for the surgical residents; however, they do provide learning experiences in post-op care because these patients are followed throughout their hospital stay and are followed in the out patient clinics. Additionally, the volume of trauma patients (which should remain the same) will provide enough cases to enable the residents to remember what they learned while on TDY. Thus there will not be a deterioration of learning opportunities if WBAMC decided to not renew Level II.

Not renewing Level II will not result in increased deaths.

Mortality rates before and after Level II status were very low. It would be inaccurate to predict a resumption of earlier mortality rates without a complete analysis of each death from both periods. Additionally, many of the surgeons who were involved in trauma before Level II no longer are stationed at WBAMC.

Civilian trauma patients do not pay their hospital bill.

The low reimbursement rate will continue due to the poverty of the trauma patients. No one would have predicted that such a small number of civilian patients would pay their bill when Level II was considered. Having the luxury of hindsight, we now know that reimbursement from the civilian trauma patients is not likely to increase in spite of our best efforts to try to collect.

Beneficiaries are more concerned with access than trauma.

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William Beaumont Army Medical Center is the preferred provider of our beneficiaries. Its beneficiaries are willing to wait to be seen there rather than go to another medical facility. Trauma care, though an important element of WBAMC, involves a relatively small percentage of WBAMC's overall patient population. The non-renewal of Level II trauma would not negatively affect our beneficiaries' attitudes because they are far more interested in issues such as access than civilian trauma.

WBAMC is not funded to subsidize trauma in El Paso.

The city of El Paso cannot blame WBAMC for the shortage of specialists such as neurosurgeons in the county. The city of El Paso and the state of Texas will have to fund the costs of acquiring the necessary clinical specialists to better serve the community. They cannot expect that WBAMC will underwrite or subsidize trauma care in El Paso indefinitely if the costs are not adequately reimbursed by MEDCOM.

Primary Mission of WBAMC

The primary mission of WBAMC is to provide medical care for its beneficiaries and maintain the military readiness of its soldiers. That is what WBAMC is funded for. If Level II trauma proves too expensive for WBAMC the leadership can decide to not renew it.

Conclusion

I have presented the major costs of maintaining Level II trauma. I not only compared WBAMC with Thomason hospital but

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with WBAMC operations in FY98, which was before Level II certification. The data was compared and validated with current research on cost of trauma care throughout the United States.

To provide the reader a better understanding of the issues, I included clinical outcome data to quantify the results. The issues surrounding trauma and GME were explored as were the question of trauma and MEDCEN linkage.

Azevedo, D. (2001). Your career guide surveying the landscape: What they're paying. Medical Economics. Retrieved November 6, 2001 from the World Wide

Web:

http://me.pdr.net/me/public.htm?path=content/journals/m/data/2001/0106/cg_miney.html

Barone, J., Ryan, M., Cayten, C., & Murphy, J. (1993). Is 24-hour operating room staff absolutely necessary for Level II trauma center designation? Journal of Trauma, 34, (6), p. 882 –883.

Bazzoli, G., Meersman, P., & Chan, C. (1996). Facts that enhance continued trauma center participation in trauma systems. Journal of Trauma, 41, (5), p. 876 – 885.

Bernstein, M. (1997). Treatment trends: Medication and managed care. Columbian Retrieved November 6, 2001 from the World Wide Web:

<http://proquest.umi.com/pqdweb?TS>

Brasel, K., Akason, J., & Weighelt, J. (1998). Dedicated operating room for trauma: A costly recommendation. Journal of Trauma, 44, (5), p. 832 –836.

Birkmeyer, J. (2000). High-risk surgery-follow the crowd. Journal of the American Medical Association, 283, (9), p. 132 – 138.

Blewett, L., Smith, M., & Caldis, T. (2001). Measuring the direct costs of graduate medical education training in Minnesota. Academic Medicine, 76, (5), p. 446 – 452.

Brasel, K., Akason, J., & Weigelt J. (1998). Dedicated operating room for trauma: a costly recommendation. Journal of Trauma, 44, 5, p. 832-838.

Bray, T. (2001). Design of the Northern Nevada Orthopaedic Trauma Panel: A model, level-II community-hospital system. American Journal of Bone Joint Surgery, 83-A, (2), p. 283 –289.

Burden of Injury in Texas. (1998). Technical notes – burden of injury in Texas. Retrieved

October 15, 2001 from the World Wide Web:

<http://www.tdh.state.tx.us/injury/reports/98burden.htm>

Bureau of Texas Department of Health. (2000). Emergency management:

Trauma systems contact. Retrieved October 15, 2001 from the World Wide Web:

<http://www.tdh.state.tx.us/hcqs/ems/etramail.htm>

Cejka, S. (2000). Physician compensation in 1998: Both specialists and primary care physicians emerge as winners. Hospital Physician, p. 61 – 68.

Centers for Disease Control. (1998). Texas: All injury deaths and raters per 100,000. Retrieved October 6, 2001 from the World Wide Web:

[http://webapp.cdc/gpv/cgi-bin/broker.exe? PROGRAM=wisgars.mortrate.sas& Service=v8prod&log=1&ty](http://webapp.cdc/gpv/cgi-bin/broker.exe?PROGRAM=wisgars.mortrate.sas&Service=v8prod&log=1&ty)

Clancy, T., Gary, M., Covington, D., Brinker, C., & Blackman, D. (2001). A statewide analysis of Level I and II trauma centers for patients with major injuries. Journal of Trauma, 51, (2), p. 346 –351.

Cook, P., Lawrence, B., Ludwig, J., & Miller, T. (1999). The medical costs of gunshot injuries in the United States. Retrieved October 29, 2001 from the World Wide Web: <http://jama.ama-assn.org/isues/v282n5/absjoc90626.html>

Coffey, R., Goldfarb, M., & Bazzolie, G. (1996). High costs for the most sophisticated trauma centers support limiting the number of such centers. Health Services Research, 31, (1), p.71 –95.

Committee on Trauma American College of Surgeons. (1999). Resources for optimal care of the injured patient.

Council on Graduate Medical Education. (2000). Financing graduate medical education in a changing health care environment. Fifteenth Report of COGME.

Cruz, L. (2002). El Paso ranked 3rd-saftest large city. Retrieved January 11, 2002 from the World Wide Web: <http://www.elpasotimes.com/stories/borderland/20020111-167073.shtml>

Trauma Cost Analysis

Defense Finance & Accounting Service (DFAS). (2001). Retrieved November 29, 2001 from the World Wide Web: www.dfas/mil.milpay/priorpay/01-2--1.pdf

Eastman, A., Rice, C., Bishop, B., & Richardson, J. (1991). An analysis of the critical problem of trauma center reimbursement. *Journal of Trauma*, 31, (7), p. 920 –925.

Geideman, J. (2000). Faith and doubt. *JAMA*, 283, (13), p. 256 – 260.

General Accounting Office. (1998). Medical readiness: Efforts are underway for DOD training in civilian trauma centers. Retrieved November 29, 2001 from the World Wide Web: <http://frwebgate.access.gpo.gov/cgi-bin/useftp.cgi?Ipaddress=162>

General Accounting Office. (1995). Military bases: analysis of DOD's 1995 process and recommendations for closure and realignment. Retrieved November 29, 2001 from the World Wide Web: <http://frwebgate.access.gpo.gov/cgi-bin/useftp.cgi?Ipaddress=ns9>

General Accounting Office. (1998). Defense health care: Collaboration and criteria needed for sizing graduate medical education. GAO/HEHS-98-121.

General Accounting Office. (1999). Defense health care: Tri-service strategy needed to justify medical resources for readiness and peacetime care. GAO/HEHS-00-10

General Accounting Office. (2000). Military personnel: Systematic analyses needed to monitor retention in key careers and occupations. GAO/NSAID-00-60.

General Accounting Office. (2001). Health workforce: Ensuring adequate supply and distribution remains challenging. GA)-01-1042

Goldberg, J. (1997). Are boom times over for primary care? *Medical Economics*, 74, (18), p. 214 - 224.

Goldberg, J. (2000). YIKES! Primary care earnings plummet. *Medical Economics*, 77, (18), p. 140 –151.

Kolenc, V. (20002). Healers hit by high premiums. Retrieved October 24, 2001 from the World Wide Web: www.borderlandnews.com/stories/business/20020217-176165.shtml

Legorreta, A., Mikos, J., Sullivan, A., & Delany, H. (1993). The high cost of hospital

trauma care: An analysis of hospital length of stay, injury severity score, case mix index, and reimbursement-to-cost ratio. Journal of the Association for Academic Minority Physicians, 4, (2), p. 52 –55.

Lewis, J. and Richards, C. (1996). Preparing an OR for Level II trauma designation. Retrieved October 24, 2001 from the World Wide Web: <http://gateway.nlm.nih.gov/gw/Cmd?GMResults>

Lucas, C., Buechter, K., Coscia, R., Hurst, J., Meredith, J., Middleton, J., Rinker, C., Tuggle, D., Vlahos, A., & Wilberger, J. (2002). Mathematical modeling to define optimum operating room staffing needs for trauma centers. Journal of American College of Surgeons, 192, (5), p. 559 – 565.

Mancuso, C., Barnoski, A., Tinnel, C., & Fallon, W. (2000). Using Trauma and Injury Severity Score (TRISS)-based analysis in the development of regional risk adjustment tools to trend quality in a voluntary trauma system: The experience of the Trauma Foundation of Northeast Ohio. Journal of Trauma, 48, (4), p. 629 –634.

Mann, N., Hedges, J., Sandoval, R., Worral, W., Zechnich, A., Jurkovich, G., & Mulins, R. (1999). Trauma system impact on admission site: A comparison of two states. Journal of Trauma, 46, (4), p. 631 – 637.

McNeil, G. (1994). Non-traditional methodology for determining the cost of graduate medical education within the Army medical department. Stimson Library MCCS HSL/Fort Sam Houston, TX.

Mechanic, R., Coleman K., & Dobson A. (1998). Teaching hospital costs: implications for academic missions in a competitive market. Journal of American Medicine Association, 280, (11), p. 1015-9.

Nathens, A., Jurkovich, G., Maier, R., Grossman, D., MacKenzie, M., & Rivara, F. (2001). Relationship between trauma center volume and outcomes. Journal of the American Medical Association, 285, (9), p.1164 –1177.

Nathens, A., Jurkovich, G., Cummings, P., Rivara, F., & Maier, R. (2000).

Trauma Cost Analysis

The effect of organized systems of trauma care on motor vehicle crash mortality.

JAMA, 283, (15), p. 1990 – 1994

Nathens, A., Maier, R., Copass, M., & Jurkovich, G. (2001). Payer status: The unspoken triage criterion. Journal of Trauma, 50, (5), p. 776 – 783.

Nathens, A., Maier, R. (2001). The relationship between trauma center volume and outcome. Advanced Surgery, 35, p. 61 –75.

Neely, K., Norton, R., Bartkus, E., & Schiver, J. (1991). Analysis of hospital ability to provide trauma services: A comparison between teaching and community hospitals. Prehospital and Disaster Medicine, 6, (4), p. 455 –458.

Norwood, S., Fernandez, L., & England, J. (1995). The early effects of implementing American College of Surgeons Level II criteria on transfer and survival rates at a rurally based community hospital. Journal of Trauma, 39, (2), p. 240 – 245.

Park, C., McGwin, G., Smith, D. May, A., Melton, S., Taylor, A. & Rue, L. (2001). Trauma-specific intensive care units can be cost effective and contribute to reduced hospital length of stay. American Surgeons, 67, (7), p. 665 –670.

Physicians. (1997). Professional and technical occupations. Retrieved October 24, 2001 from the World Wide Web: <http://www.bls.gov/oco/ocos074.htm>

Reducing the Burden of Injury. (1999). Advancing prevention and treatment. Retrieved October 15, 2001 from the World Wide Web:

<http://www.nap.edu/readingroom/books/burden/>

Rodenberg, H. (1996). The Florida trauma system: Assessment of a statewide data base. Injury, 27, (3), p. 205 –208.

Rutledge, R., Shaffer, V., & Ridky, J. (1996). Trauma care reimbursement in rural hospitals: implications for triage and trauma system design. Retrieved December 6, 2001 from the World Wide Web: <http://www.tdh.state.tx.us/hcqes/ems/etramail.htm>

Sartorelli, K., Rogers, F., Osler, T., Shaford S., Cohen, M. & Vane, D. (1999). Financial aspects of providing trauma care at the extremes of life. Retrieved December 6, 2001 from the World Wide Web:

0C

Silka, P., Geiderman, J., & Kim, J. (2001). Diversion of ALS ambulances: Characteristics, causes, and effects in a large urban system. Prehospital Emergency Care, 5, (1), p. 23 –28.

Stewart, T. (2000). Seminars in perioperative nursing. W. B. Saunders. Philadelphia, Pa.

Taheri, P., Butz, D., & Greenfield, L. (1999). Paying a premium: how patient complexity affects costs and profit margins. Ann Surg, 229, (6), p. 807 – 811.

Taherum O., Butz, D., & Greenfield, L. (2000). Length of stay has minimal impact on the cost of hospital admission. Journal of the American College of Surgeons. Retrieved October 16, 2001 from the World Wide Web:

http://www.facs.org/dept/jacs/lead_articles/aug00lead.html

Tepas, J., Patel, J., DiScala, C., Wears, R., & Veldenz, H. (1998). Relationship of trauma patient volume to outcome experience: Can a relationship be defined? Journal of Trauma, 44, (5), p. 827 – 830.

Texas Department of Health. (2000). Hospital trauma reporting guidelines. Retrieved October 15, 2001 from the World Wide Web:

<http://www.tdh.state.tx.us/injury/trauma/hguide2.htm>

Texas Department of Health. (2000). Trauma registry overview. Retrieved October 15, 2001 from the World Wide Web:

<http://www.tdh.state.tx.us/injury/trauma/overview.htm>

Texas Department of Health.. (2000). Texas trauma facilities. Retrieved October 15, 2001 from the World Wide Web:

<http://www.tdh.state.tx.us/hcqs/ems/Etrahosp.htm>

Texas Department of Health. (1999). Major trauma injuries by sex and age. Retrieved October 15, 2001 from the World Wide Web:

<http://www.tdh.state.tx.us/injury/reports/99inj/99inj03.htm>

Trauma Cost Analysis

Texas Department of Health. (1998). Major trauma injuries admitted in Texas hospitals by cause. Retrieved October 15, 2001 from the World Wide Web:

<http://www.tdh.state.tx.us/injury/reports/inj98pie.htm>

Texas Perspective. (2000). Motor – vehicle safety: a 20th century public health achievement. Retrieved October 15, 2001 from the World Wide Web:

http://www.tdh.state.tx.us/injury/reports/mvccdc/mcv_cdc.htm

The American Academy of Orthopaedic Surgeons Bulletin. (2001). Small salary gains expected: Change in compensation will be linked to productivity.

Retrieved November 6, 2001 from the World Wide Web:

<http://www.aaos.org/wordhtml/bulletin/feb01/fine2.htm>

Thompson, C., Bickell, W., Siemens, R., & Sacra, J. (1992). Community hospital Level II trauma center outcome. Journal of Trauma, 32, (3), p. 336 – 341.

Tucker, J., Barone, J., Cecere, J., Blabey, R., & Rha, C. (1999). Using queueing theory to determine operating room staffing needs. Journal of Trauma, 46, (1), p. 71 – 79.

Trauma Care Reimbursement Fund (2002). Retrieved February 1, 2002 from the World Wide Web: <http://www4.law.cornell.edu/uscode/42/300d.text.html>

Tucker, J., Barone, J., Cecere, J., Blabey, R., & Rha, C. (1999). Using queueing theory to determine operating room staffing needs. Journal of Trauma, 46, 1, p.71 – 79.

Tyke, S. (2000). Smart training: The US Army's pilot project for combat trauma surgical training. Seminars in Perioperative Nursing, 9, (1), p. 11 –16.

US Code: Title 42, Section 300d. (2000). Establishment.

Retrieved October 16, 2001 from the World Wide Web:

<http://www4.law.cornell.edu/uscode/42/300d.text.html>

US Code: Title 42, Section 300d-41. (2000). Grants for certain trauma centers.

Retrieved October 16, 2001 from the World Wide Web:

<http://www4.law.cornell.edu/uscode/42/300d-41.text.html>

Trauma Cost Analysis

Voelker, Rebecca. (2000). Access to trauma. Journal of American Medical Association. Retrieved October 29, 2001 from the World Wide Web:

<http://jama.ama-assn.org/issues/v284n16/ffull/jqu00008-1.html>

Wagner, S. (1997). Cost analysis of emergency medical services at William Beaumont Army Medical Center. Stimson Library MCCS HSL/Fort Sam Houston, TX.

Walton, D. (1995). Civilian Emergencies: what are the charges associated with treating these patients at Wilford Hall Medical Center? Stimson Library MCCS HSL/Fort Sam Houston, TX.

Wenneker, W., Murray, D., & Ledwich, T. (1990). Improved trauma care in a rural hospital after establishing a Level II trauma center. American Journal of Surgery, 160, (6), p. 655 –658.

Wynn, A., Wise, M., Wright, M., Rafaat, A., Wang, Y., Steeb, G., McSwain, N., Beuchter, K., & Hunt, J. (2001). Accuracy of administrative and trauma registry databases. Journal of Trauma, 51, (3), p. 464 –468.